TRUMPF

Whitepaper

3D laser cutting technology for secondary processing of metal formed parts

Contents

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Abstract

There are many limitations when it comes to incorporating secondary processes into the forming process. The process is labor intensive and requires highly skilled workers. Often times, deburring is required and in the end, low-quality results are achieved.

3D laser cutting serves as an ideal secondary process for handling metal formed parts, as well as handling hot stamped steel. TRUMPF offers a 5-axis laser cutting machine that is perfect for the job. The TRUMPF TruLaser Cell 5030 machine achieves high-quality results by eliminating steps in the manufacturing process and labor intensity, while decreasing costs. Read more about the benefits of 3D laser cutting to determine if this is the right solution for you.

Situation

For more than a decade, 3D laser cutting technology has been recognized as the only process capable of handling hot stamped steel in automotive mass production environments. With its increasing capabilities and flexibilities, 3D laser cutting has also gained popularity in secondary processing of metal formed parts due to its high quality, efficiency and process reliability.

Forming is a common manufacturing process in today's metal fabrication world. The most well-known forming technologies include hot stamping, deep-draw stamping, hydro-forming, metal spinning and tube bending.

At its core, forming is a method for turning raw materials into 3D shapes. Before final assembly, however, it's usually required to cut out holes and trim flanges on the 3D parts. Given the complexity of the metal forming process, sometimes it's difficult, if not impossible, to incorporate these functions into the forming process. As a result, secondary processing of the metal formed parts is often required.

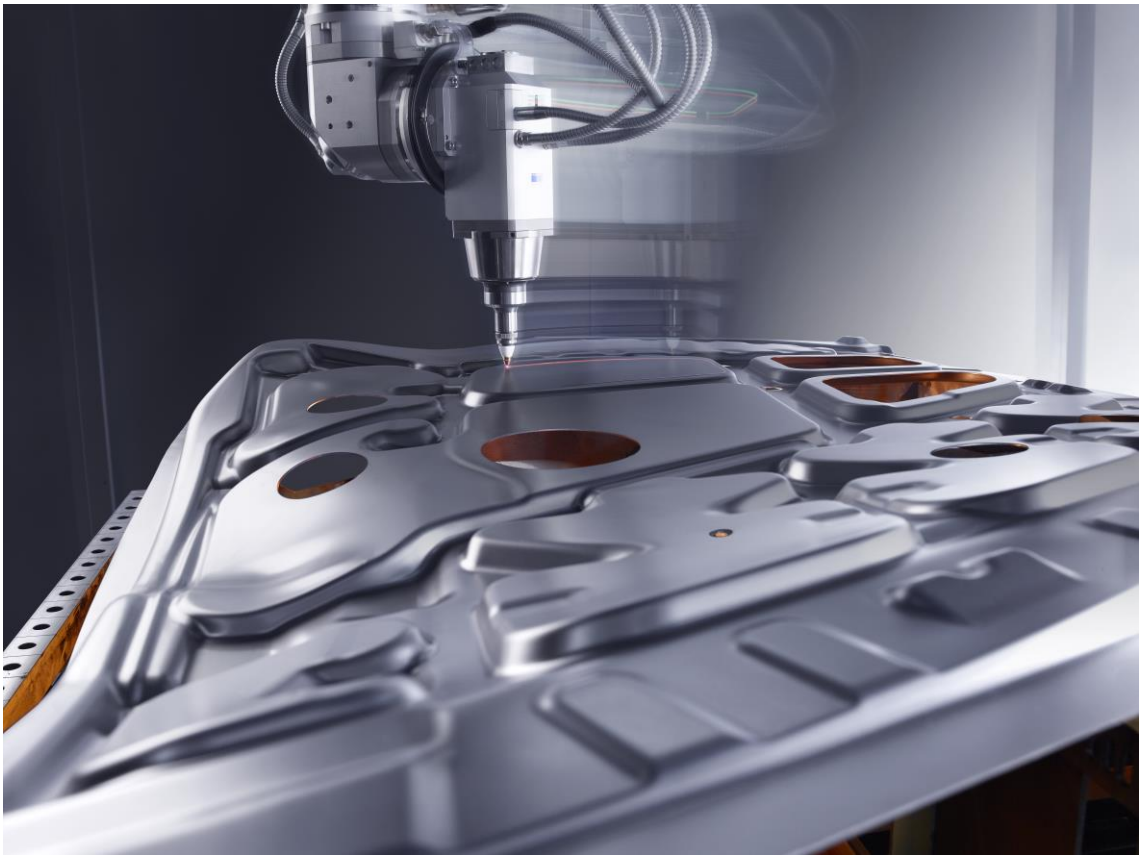

Figure 1:
Laser cutting of a car component in the TruLaser Cell 5030.

Traditional limitations

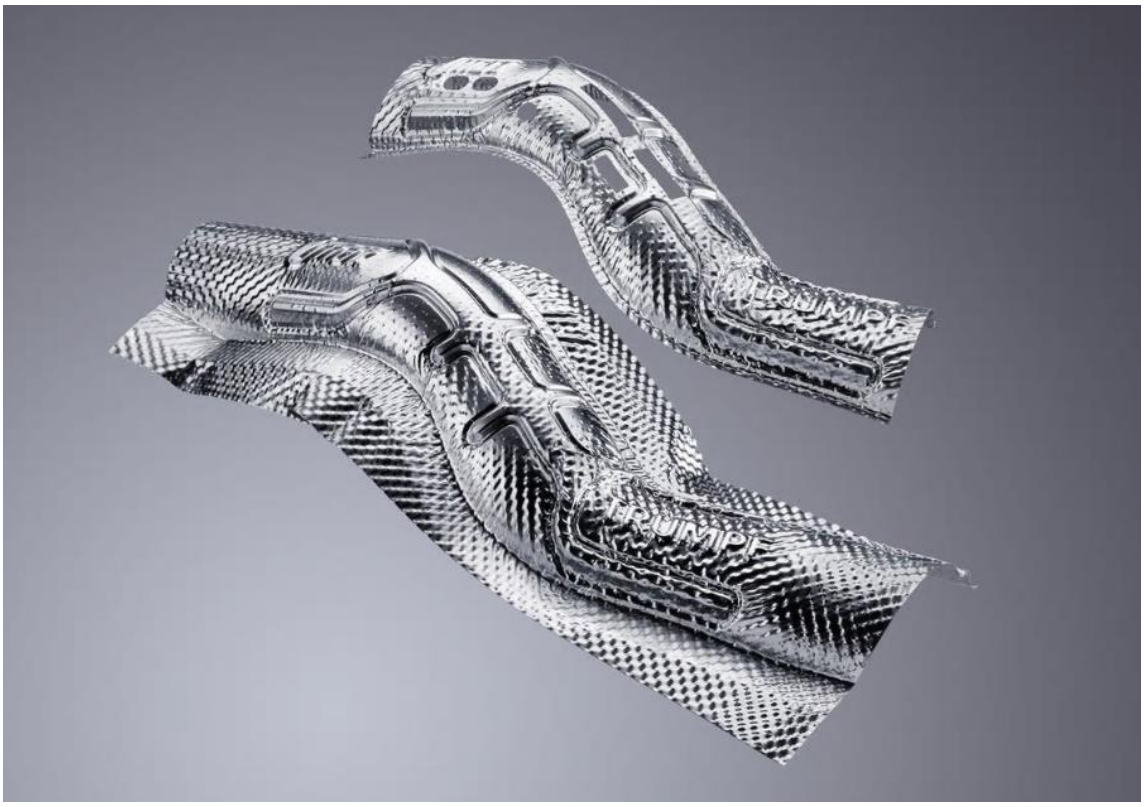

Figure 1: Example of secondary processing for heat shields.

Traditional methods for incorporating secondary processes into the forming process typically involve custom dies and punches or a bandsaw. A typical process can be described in the following manner:

01	Make a fixture to conform to and secure the part with repeatable positioning
02	Choose the right tool: custom die, custom punch, drill, saw, hand tool or CNC machine tool
03	Accurately locate holes and flanges on the 3D surface in relation to the tool
04	Process the part without deforming it
05	Deburr and rework to meet edge quality requirements
06	Modify fixture and tool if design changes

The process requires highly skilled workers and is labor intensive while process repeatability is hard to achieve. To add insult to injury, the design, build and inventory of custom fixtures and dies as well as high rates of scrap parts and multiple operational steps add up quickly in the form of time and cost. The limitations of traditional methods are wide ranging.

Historically, these secondary processes produce low-quality results. High positional accuracy and repeatability at ±0.01 in. or greater is hard to achieve, thin materials are easily deformed and post-processing such as deburring is often required. Flexibility can also be an issue. Small lot sizes and large varieties of parts require fast and accurate setups, and it is difficult to make adjustments and changeovers. The overall higher costs can include extensive labor, low throughput and high scrap rates. Small lot sizes typically do not justify the tooling investment. The design, building and inventory required for custom fixtures and dies ramp up manufacturing costs, as well.

3D cutting solution

It's easy to see where a traditional approach falls short, but what does an optimal 3D cutting solution look like?

- The 3D part is efficiently positioned and accurately located
- The part is cut with high edge quality; no deburring required
- There is no deforming of the cut part
- Ability to handle a variety of materials from 0.01 in. to 0.5 in. thick
- Simple and reliable fixturing or tooling
- Short turnaround times; quick setups and fast changeovers
- Flexible: Easy to make adjustments based on design changes
- Less parts handling and hazards for the operator
- Environmentally friendly
- Reasonable costs

The key, therefore, to low-volume, high-quality production is all about using the right technology to streamline the manufacturing process, eliminate manufacturing steps and manual labor, and minimize tooling costs. In many manufacturing technologies, 5-axis laser cutting technologies stand out as a solution to address these challenges.

With the latest development of modern features and smart functions, secondary processing of metal formed parts has been made easier for operators by utilizing 5-axis laser cutting. And in that regard, TRUMPF, Inc. offers a complete solution that includes 5-axis laser cutting machines, such as the company's TruLaser Cell series, that utilize a fiber-delivered solid-state laser and offline programming software.

At TRUMPF, the 3D laser cutting solution starts with TruTops Cell, an offline programming system for 3D machining and the interface between the CAD system and the multi-axis laser machine. The executable, process-reliable NC program is generated offline while the machine is in production. Compatibility is important so that offline programming software does not only know the correct tool path, but also the technology and machine's unique features to access extensive process rules.

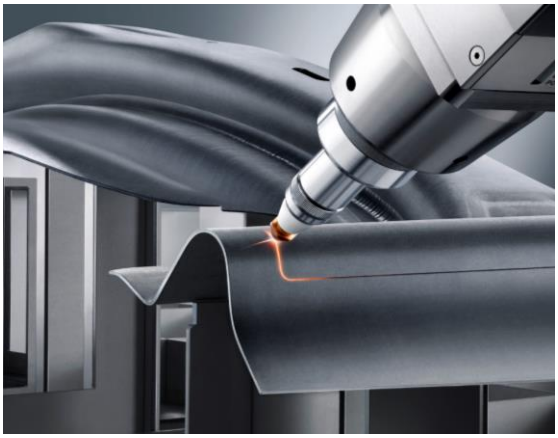

Figure 1:
3D laser cutting of formed metal parts.

Fundamental features

What is also important for fabricators is the capability to make simple and low-cost fixtures. When generating the fixture, TruTops Cell uses the cutting path defined in the X and Y direction to generate the entire 3D fixture and the 2D unfolding for the supports. These fixture plates can be cut on the same 5-axis machine being used for the 3D laser cutting or the fixture parts can be exported as DXF files to cut with a TruTops 2D laser.

Automatic focus adjustment is also key because high laser cutting quality is the result of an optimal combination of cutting parameters, including laser power, focus, speed, gas pressure and piecing strategy. To that end, TRUMPF experts have integrated optimized laser cutting parameters in the machine control system. Operators only need to select the material and thickness and then the machine chooses the correct parameters, which result in high quality cuts.

In that regard, the TruLaser Cell series machines are equipped with FocusLine technology, a function to adjust laser focus position automatically. With FocusLine, the machine can set the laser focus point as desired to achieve burr-free cutting for different materials of varied thickness without manual adjustment.

Another feature offered within the TruLaser Cell is X-Blast technology, which allows operators to double the working distance between the nozzle and workpiece and also double the bandwidth. This greatly reduces the chance of nozzle collisions and, therefore, reduces interruptions during the production process. At the same time, the machine can cut complicated shapes at a very high quality, resulting in stable and reproducible quality parts.

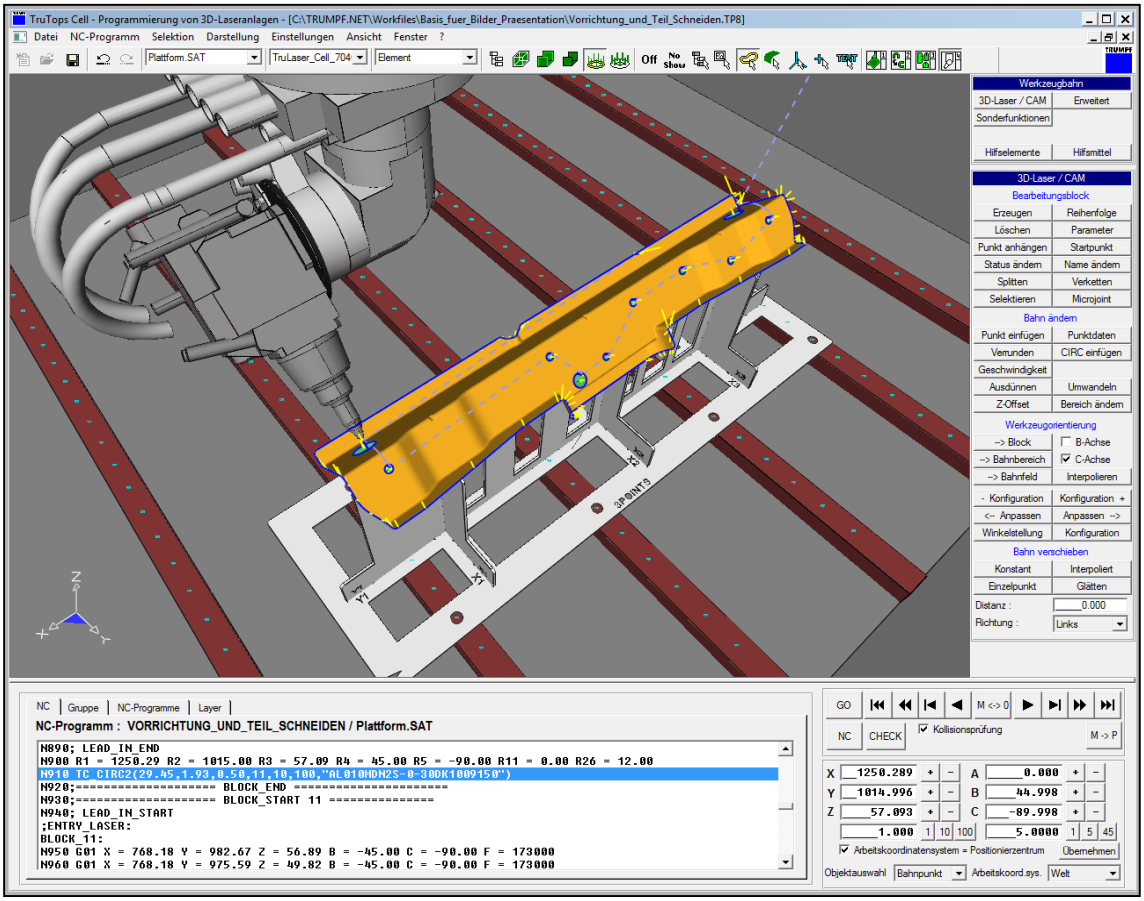

Figure 1: TRUMPF's own offline programming software TruTops Cell.

Fast turn-around from design to production

Figure 1: TruLaser Cell 5030 performance compared to a traditional hybrid machine.

Prototype and low-volume manufacturers face the challenge of constant part changeover, so quick setup and adjustment are the keys to success. Knowing that, TRUMPF successfully transferred many of the proven smart functions from the TruLaser Cell series into the newly designed TruLaser Cell 5030 to reduce setup time.

The magnetic clutch prevents damages to the cutting optics from a crash, and it can be restored within just a few minutes. To verify that the machine is in perfect condition before cutting, the operator can benefit from a new function, ObserveLine Professional, to verify optical alignment within a few seconds.

Should there be any misalignment detected, operators can use the Smart Optics Setup, a swivel device mounted on the machine body that allows automatic optics orientation and thus adjusts the optics alignment through the power NC control system.

Another feature is TruTops Cell Basic, an online tool that allows operators to make quick adjustments, such as move contours, change points, change diameters, and insert micro joints by a few mouse clicks. Furthermore, every change can be visualized with the process path and cutting head shown on the machine control panel. Instead of going through lines of NC code, operators can make changes with confidence with just a few clicks, significantly reducing the adjustment time after the first cut.

Thanks to these important features, fabricators can see higher productivity and lower costs, enhancing their competitive advantages in 3D laser cutting. And with TRUMPF's energy-efficient TruDisk laser and flying optics, the TruLaser Cell 5030's productivity is tremendously boosted. Compared to traditional hybrid 3D machines with a CO_2 laser source, the machine productivity is increased by 200 percent while operating costs are reduced by nearly 50 percent. As a result, the cost per job is significantly reduced.

When it comes to 3D laser cutting for prototype and low- to medium-volume production, the user of a TruLaser Cell 5030 can not only produce parts quicker with higher quality, but can also produce them at greatly lower costs. Considering all factors, including programming software, ease of setup, quick changeovers, cutting quality and reliability, 3D laser cutting technologies represent the most effective and efficient manufacturing solution in secondary processing of 3D metal formed parts.

Figure 2: Magnetic clutch for collision protection and quick optics changeover.

Equipment

Figure 1: The TRUMPF TruLaser Cell 5030.

Technical data	
Axis travel range	
X Axis travel range	3000 mm
Y Axis travel range	1500 mm
Z Axis travel range	700 mm
B Axis travel range	± 135 °
C Axis travel range	n x 360 °
Maximum workpiece size	
Maximum workpiece size in X	2540 mm
Maximum workpiece size in Y	1040 mm
Maximum workpiece size in Z	470 mm
Maximum axis speeds	
Maximum axis speed, axially parallel in X	60 m/min
Maximum axis speed, axially parallel in Y	60 m/min
Maximum axis speed, axially parallel in Z	60 m/min
Maximum axis speed, simultaneous	104 m/min
Maximum axis speed of B axis	60 1/min
Maximum axis speed of C axis	60 1/min
Maximum axis accelerations	
Maximum axis acceleration, axially parallel in X	5 m/s^2
Maximum axis acceleration, axially parallel in Y	5 m/s^2
Maximum axis acceleration, axially parallel in Z	5 m/s^2
Maximum axis acceleration, simultaneous	8 m/s^2
Maximum axis acceleration of B axis	200 rad/s^2
Maximum axis acceleration of C axis	100 rad/s^2
Positioning accuracy	
Positioning accuracy of linear axes (X, Y, Z)	0.08 mm
Positioning accuracy of rotary axes (B)	0.015 °
Laser	
Maximum laser power	2000 W – 4000 W
Available lasers	TruDisk

Subject to alteration. Only specifications in our offer and order confirmation are binding.

Materials

The TruLaser Cell 5030 is well suited for small and medium lot sizes that involve applications with frequently changing components. This laser has the ability to process several different types of materials. Some of the materials consist of aluminum alloys, state-of-the-art steel alloys, galvanized sheet metal, mild steel, and much more. From thick to thin, you process everything on the same machine.

Figure 1: The TRUMPF TruLaser Cell 5030 laser cutting machine ensures the best results for laser processing.

Conclusion

3D laser cutting with the TRUMPF TruLaser Cell 5030 is the perfect tool for secondary processing of metal formed parts. Traditional methods include a wide range of limitations and the process itself is very long. Precious time is consumed, yet you receive low-quality results. 3D laser cutting addresses all the challenges caused by traditional methods and offer the perfect solution. Maximize your productivity and reduce your costs with 3D laser cutting.

Find more information on our TRUMPF TruLaser Cell 5030, please visit our website.

TRUMPF

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